

Claims

- [c1] 1. An apparatus for depositing an overlay weld on a boiler tube panel comprising a plurality of tubes with adjacent tubes joined together with membranes therebetween, the apparatus comprising:
- means for supporting the boiler tube panel during overlay welding thereof, the supporting means comprising a frame adapted to support the boiler tube panel by contacting a first surface thereof, at least one welding carriage mounted adjacent the frame and adapted for travel along the frame, and an overlay welding head mounted to the welding carriage and adapted for depositing an overlay weld on a second surface of the boiler tube panel oppositely disposed from the first surface of the boiler tube panel; and
- means for straightening the boiler tube panel following deposition of the overlay weld on the second surface of the boiler tube panel, the straightening means comprising a first member having a contact surface with a profile that is complementary to the first surface of the boiler tube panel, a second member having a contact surface with a profile that is complementary to the second surface of the boiler tube panel, means for causing the first

and second members to move toward each other to press a portion of the boiler tube panel therebetween and for causing the first and second members to move away from each other to release the boiler tube panel, and means for positioning the boiler tube panel between the first and second members.

- [c2] 2. The apparatus according to claim 1, wherein the frame is horizontal and the boiler tube panel lies on the frame so that the second surface of the boiler tube panel faces upward.
- [c3] 3. The apparatus according to claim 1, wherein the supporting means further comprises a track attached to the frame and oriented parallel to a longitudinal direction of the boiler tube panel on the supporting means, the welding carriage being mounted to the frame for travel along the frame in the longitudinal direction of the boiler tube panel.
- [c4] 4. The apparatus according to claim 3, wherein the welding carriage comprises an arm adapted to move the overlay welding head in a transverse direction of the boiler tube panel.
- [c5] 5. The apparatus according to claim 1, wherein the frame comprises:

a plurality of frame members spaced apart so as to define slots therebetween; and
retaining members having first portions received in the slots and second portions adapted for engaging lateral edges of the boiler tube panel.

- [c6] 6. The apparatus according to claim 5, wherein the retaining members are mounted in the slots for movement in a transverse direction of the boiler tube panel.
- [c7] 7. The apparatus according to claim 1, wherein the supporting means further comprises a header bar and an oppositely-disposed tail bar, the header bar being adapted for securing a first longitudinal end of the boiler tube panel to the frame and the tail bar being adapted for securing an oppositely-disposed second longitudinal end of the boiler tube panel to the frame.
- [c8] 8. The apparatus according to claim 1, further comprising means for providing a feedback signal indicating travel speed of the weld carriage along the frame.
- [c9] 9. The apparatus according to claim 1, further comprising means for delivering a shielding gas to the overlay welding head and means for providing a feedback signal indicating shielding gas pressure.
- [c10] 10. The apparatus according to claim 1, further compris-

ing means for providing a feedback signal indicating distance between the overlay welding head and the second surface of the boiler tube panel.

[c11] 11. The apparatus according to claim 1, further comprising means for feeding a filler material to the overlay welding head and means for providing a feedback signal indicating the speed at which the filler material is fed to the overlay welding head.

[c12] 12. The apparatus according to claim 1, wherein the second member is stationary on the straightening means and the first member is movable relative to the second member.

[c13] 13. The apparatus according to claim 1, wherein the straightening means further comprises means for moving the first member in a direction parallel to the second member.

[c14] 14. The apparatus according to claim 13, wherein the first member is sized to engage less than the transverse width of the boiler tube panel, and the moving means is operable to cause the first member to travel in the transverse direction of the boiler tube panel.

[c15] 15. An apparatus for depositing an overlay weld on a boiler tube panel comprising a plurality of tubes with ad-

adjacent tubes joined together with membranes therebetween, the apparatus comprising:

means for supporting the boiler tube panel during overlay welding thereof, the supporting means comprising: an elongate frame sized to accommodate the boiler tube panel and horizontally support the boiler tube panel by contacting a first surface of the boiler tube panel while an oppositely-disposed second surface thereof faces upward;

means for securing oppositely-disposed longitudinal ends and oppositely-disposed transverse edges of the boiler tube panel to the frame;

at least one welding assembly mounted adjacent the frame and adapted for travel along the frame in a longitudinal direction of the boiler tube panel, the welding assembly comprising an arm adapted for movement in a transverse direction of the boiler tube panel; and

an overlay welding head mounted to the arm of the welding assembly and adapted for depositing an overlay weld on the second surface of the boiler tube panel; and means for straightening the boiler tube panel following deposition of the overlay weld on the second surface of the boiler tube panel, the straightening means comprising:

a stationary member having a contact surface with a profile that is complementary to the second surface of

the boiler tube panel, the stationary member being sized to engage substantially all of the transverse width of the boiler tube panel;

a ram member having a contact surface with a profile that is complementary to the first surface of the boiler tube panel, the ram member being sized to engage less than the transverse width of the boiler tube panel;

means for actuating the ram member toward and away from the stationary member in directions normal to the stationary member, the actuating means operating to cause the ram member to move toward the stationary member to press a portion of the boiler tube panel therebetween, and the actuating means operating to cause the ram member to move away from the stationary member to release the boiler tube panel;

means for moving the ram member in a direction parallel to the stationary member and in the transverse direction of the boiler tube panel; and

means for positioning the boiler tube panel between the ram and stationary members.

- [c16] 16. A process for depositing an overlay weld on a boiler tube panel comprising a plurality of tubes with adjacent tubes joined together with membranes therebetween, the process comprising the steps of:
supporting the boiler tube panel and then overlay weld–

ing the boiler tube panel, the boiler tube panel being supported on a frame that contacts a first surface of the boiler tube panel, the overlay welding being carried out with at least one overlay welding head supported by a welding carriage traveling along the frame, the overlay welding head depositing an overlay weld on a second surface of the boiler tube panel oppositely disposed from the first surface of the boiler tube panel;

positioning the boiler tube panel between first and second members, the first member having a contact surface with a profile that is complementary to the first surface of the boiler tube panel, the second member having a contact surface with a profile that is complementary to the second surface of the boiler tube panel;

straightening the boiler tube panel by moving the first and second members toward each other so that the first surface of the boiler tube panel is contacted with the contact surface of the first member, the second surface of the boiler tube panel is contacted with the second member, and a portion of the boiler tube panel is pressed therebetween; and then

moving the first and second members away from each other to release the boiler tube panel.

[c17] 17. The process according to claim 16, wherein the frame is horizontal and the boiler tube panel lies on the

frame during the supporting and welding step so that the second surface of the boiler tube panel faces upward.

- [c18] 18. The process according to claim 16, wherein the welding carriage comprises an arm that moves the overlay welding head in a transverse direction of the boiler tube panel during the supporting and welding step.
- [c19] 19. The process according to claim 16, wherein oppositely-disposed longitudinal ends and oppositely-disposed lateral edges of the boiler tube panel are secured to the frame during the supporting and welding step.
- [c20] 20. The process according to claim 16, further comprising the steps of:
- providing a feedback signal indicating travel speed of the weld carriage along the frame;
 - delivering a shielding gas to the overlay welding head;
 - providing a feedback signal indicating shielding gas pressure;
 - providing a feedback signal indicating distance between the overlay welding head and the second surface of the boiler tube panel;
 - feeding a filler material to the overlay welding head; and
 - providing a feedback signal indicating the speed at which the filler material is fed to the overlay welding

head.

- [c21] 21. The process according to claim 16, wherein only the first member is moved during the straightening step.
- [c22] 22. The process according to claim 16, wherein the first member is sized to engage less than the transverse width of the boiler tube panel during the straightening step.
- [c23] 23. The process according to claim 22, wherein during the straightening step the boiler tube panel is released by moving the first and second members away from each other, the first member is moved in a direction parallel to the second member, and then the first and second members are moved toward each other to press a second portion of the boiler tube panel therebetween.
- [c24] 24. The process according to claim 23, wherein the first member travels in the transverse direction of the boiler tube panel when moved parallel to the second member.
- [c25] 25. A process for depositing an overlay weld on a boiler tube panel comprising a plurality of tubes with adjacent tubes joined together with membranes therebetween, the process comprising the steps of:
horizontally supporting the boiler tube panel on an elongate frame that contacts a first surface of the boiler tube

panel so that an oppositely-disposed second surface of the boiler tube panel faces upward;

overlay welding the second surface of the boiler tube panel with at least one overlay welding head supported by an arm of a welding carriage, the welding carriage moving the overlay welding head in a longitudinal direction of the boiler tube panel and the arm moving the overlay welding head in a transverse direction of the boiler tube panel;

positioning the boiler tube panel between ram and stationary members, the ram member having a contact surface with a profile that is complementary to the first surface of the boiler tube panel, the stationary member having a contact surface with a profile that is complementary to the second surface of the boiler tube panel, the ram member being sized to engage less than the transverse width of the boiler tube panel, the stationary member being sized to engage substantially all of the transverse width of the boiler tube panel;

straightening a first portion of the boiler tube panel by moving the ram member toward the stationary member so that the first surface of the boiler tube panel is contacted with the contact surface of the ram member, the second surface of the boiler tube panel is contacted with the stationary member, and the first portion is pressed therebetween;

releasing the boiler tube panel by moving the ram member away from the stationary member;
moving the ram member in a direction parallel to the stationary member and transverse to the boiler tube panel;
moving the ram member toward the stationary member to press a second portion of the boiler tube panel therebetween; and then
moving the ram member away from the stationary member to release the boiler tube panel.